Photonic lanterns for image reconstruction with FIRST-PL, a demonstration with HIP81126.

FIRST-PL is an instrument integrated to the extreme-adaptive optics bench SCExAO on the Subaru Telescope (Hawaii). FIRST-PL was recently opened for science operations, making it the first instrument available to the community to utilize a photonic lantern for spectro-imaging at high angular resolution. A photonic lantern is a passive optical component used to direct the light coming from the telescope from a multimode fiber (MMF) into several single mode fibers (SMF). The gradual transition from MMF to SMF allows a high transmission of the light (90%).

On FIRST-PL, the photonic lantern is used as an integral field spectrometer : the light from each SMF is dispersed (630-780nm) and allows either spectro-astrometric measurements (below the diffraction limit of the telescope) or the reconstruction of images, which is the mode used for the observation of HIP81126 realized in may 2025.

The instrument can observe targets with an angular resolution reaching 20 mas and can be used either on-axis or off-axis, the second mode extending the field of view from 130 to 1000 mas to reach a companion at a known position. Images can be reconstructed by analyzing the output of each SMF as a function of wavelength against the response of the photonic lantern on a bright calibration target. During this presentation, I will introduce these observational modes and the method for image reconstruction applied to HIP81126 for data taken both on- and off-axis.

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